



Technical Standard Order

Subject: Ground Based Augmentation System Positioning and Navigation Equipment

1. **PURPOSE.** This Technical Standard Order (TSO) tells manufacturers seeking a TSO authorization or letter of design approval what minimum performance standards (MPS) their airborne navigation equipment using the Global Positioning System (GPS) augmented by the Ground Based Augmentation System (GBAS), for example the U.S. Local Area Augmentation System (LAAS), must first meet for approval and identification with the applicable TSO marking.
2. **APPLICABILITY.** This TSO is effective for new applications submitted after the effective date of this TSO.
3. **REQUIREMENTS.** New models of GBAS equipment that are identified and manufactured on or after this TSO's effective date must meet the MPS for the Positioning and Navigation (PAN) equipment in Section 2 of RTCA/DO-253A, "Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment," dated November 28, 2001.
 - a. **Functionality.** This TSO's standards apply to equipment designed to output deviations relative to a precision approach path using GBAS, and to provide position information to a navigation management unit that outputs deviation commands referenced to a desired flight path. The positioning and navigation functions are defined in Section 1.4 of RTCA/DO-253A.
 - b. **Failure Condition Classification.** Failure of the function defined in paragraphs 3 and 3a of this TSO is a major failure condition for malfunction of position data and a hazardous failure condition for the malfunction of precision approach navigation data. The manufacturer must develop the system to at least the design assurance level commensurate with this hazard classification. While this is the minimum standard, a more severe hazard classification may apply depending on the intended use of the equipment in its installed configuration.
 - c. **Functional Qualification.** Demonstrate the required performance under the test conditions and procedures in RTCA/DO-253A, Section 2.5. Using test procedures other than those in Section 2.5.3 of RTCA/DO-253A constitutes a deviation to this TSO.

d. Environmental Qualifications. The equipment shall be subject to the test conditions in RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment," dated July 29, 1997.

e. Software Qualifications. If the article includes software, develop the software according to Sections 2 through 12 and Annex A of RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," dated December 1, 1992.

f. Deviations. The Federal Aviation Administration (FAA) has provisions for using alternative or equivalent means of compliance to the criteria in the MPS of this TSO. Manufacturers invoking these provisions shall demonstrate that an equivalent level of safety is maintained and shall apply for a deviation per 14 CFR § 21.609.

4. MARKING. Under 14 CFR § 21.607(d), mark articles manufactured under this TSO as follows:

a. Permanently and legibly mark at least one major component with all of the information in 14 CFR § 21.607(d), except for the option in 14 CFR § 21.607(d)(2), where the name, type and part number must be used in lieu of the optional model number. The exception also falls under the option in 14 CFR § 21.607(d)(3), where the date of manufacture must be used in lieu of the optional serial number.

b. In addition to the requirements of 14 CFR § 21.607(d), permanently and legibly mark each separate component that is easily removable (without hand tools), each interchangeable element, and each separate sub-assembly of the article that the manufacturer determines may be interchangeable with at least the name of the manufacturer, manufacturer's sub-assembly part number, and the TSO number.

c. If the component includes software, then the part number must include hardware and software identification. Manufacturers may also use a separate part number for hardware and software. Either approach must include a way to show the modification status. Note that similar software versions, which have been approved to different software levels, must be differentiated by part number.

d. When applicable, identify the article as either an incomplete system or an article that accomplishes additional functions beyond that described in paragraphs **3** and **3a** of this TSO.

5. DATA REQUIREMENTS.

a. Application Data. Under 14 CFR § 21.605(a)(2), the manufacturer must provide the Manager, Aircraft Certification Office (ACO), FAA, who is responsible for the manufacturer's facilities, with one copy of each of the following technical data to support the FAA design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the equipment's operational capability. In particular, operational or installation limitations resulting from specific deviations granted must be described in detail.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the equipment, when installed according to the installation procedures, continues to meet this TSO's requirements. The limitations shall identify any unique aspects of the installation. The limitations shall include at least the following:

(a) A note with the following statement:

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

(b) Adequate specification of the interface between the equipment and other systems to ensure proper functioning of the integrated system. This must include maximum tolerable currents and voltages into the antenna port if the equipment is installed with a standard antenna (TSO-C144, Airborne Global Positioning System Antenna).

(c) If the equipment only satisfies RTCA/DO-253A's requirements when used with a particular antenna, the use of that antenna (by part number) must be specified as a limitation.

(d) If the software qualification limits the equipment's eligibility on certain aircraft types, identification of the qualification level and identification that the equipment has not been determined to be eligible for all aircraft types must be specified as a limitation (e.g., AC 23-1309-1C, "Equipment, Systems, and Installations in Part 23 Airplanes," states that the RTCA/DO-178B Level C software may be associated with a hazardous failure condition for certain aircraft types). Identify other limitations that apply to the failure condition classification (e.g., two installed units are necessary).

(e) When applicable, identify the article as an incomplete system or a multi-use system and describe the functions that the article is intended to provide.

(3) Schematic drawings, as applicable to the installation procedures.

(4) Wiring drawings, as applicable to the installation procedures.

(5) List of the components, by part number, that make up the equipment complying with the standards in this TSO. Manufacturers should include vendor part number cross-references when applicable.

(6) Instructions, in the form of a Component Maintenance Manual (CMM) containing information on the periodic maintenance, calibration and repair, for the continued airworthiness of installed equipment. This also includes recommended inspection intervals and service life.

(7) An environmental qualifications form for each component of the system described in RTCA/DO-160D.

(8) Materials and process specifications list.

(9) The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a) including functional test specifications that test each production article to ensure compliance with this TSO.

(10) Manufacturer's TSO qualification test report.

(11) Nameplate drawing providing the information required by paragraph 4 of this TSO.

(12) A list of all drawings and processes, including revision level, that are necessary to define the article's design. In the case of a minor change, any revisions to the drawing list need only be made available upon request.

(13) If the article includes software: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. The FAA recommends submitting the PSAC early in the software development process. Early submittal allows timely resolution of issues such as partitioning and determination of software levels.

b. Manufacturer Data. In addition to the data given directly to the FAA, each manufacturer must have the following technical data available for review by the manager of the ACO that is responsible for the manufacturer's facilities:

(1) The functional qualification specifications that qualify each production article to ensure compliance with this TSO.

(2) Equipment calibration procedures.

(3) Corrective maintenance procedures (within 12 months after TSO authorization).

(4) Schematic drawings.

(5) Wiring diagrams.

(6) Material and process specifications.

(7) The results of the environmental qualification tests conducted according to RTCA/DO-160D.

(8) If the article includes software, the appropriate documentation in RTCA/DO-178B including all data supporting the applicable objectives found in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

(9) Qualification test procedures used to determine compliance with this TSO.

c. Furnished Data.

(1) One copy of the data and information in paragraphs **5(a)(1)** through **(7)** of this TSO, any other data or necessary information for proper installation, certification and use, or for continued airworthiness of the equipment, must accompany each article manufactured under this TSO.

(2) If the appliance accomplishes any additional functions beyond those in paragraph **3** and **3a** of this TSO, then a copy of the data and information in paragraphs **5(a)(11)** through **(12)** that pertain to those functions must also go to each person receiving one or more articles manufactured under this TSO for use.

6. AVAILABILITY OF REFERENCED DOCUMENTS

a. You may purchase copies of RTCA/DO-160D, DO-178B, and DO-253A from RTCA Inc., 1828 L Street, N.W., Suite 805, Washington, D.C. 20036 or their website at www.rtca.org.

b. You may purchase copies of Federal Aviation Regulations 14 CFR part 21, Subpart O from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402-9325. Copies also can be obtained from the Government Printing Office (GPO), electronic CFR Internet website at www.access.gpo.gov/ecfr/.

c. You may request Advisory Circular (AC) 20-110, "Index of Aviation Technical Standard Orders," and AC 20-36, "Index of Articles Certified under the Technical Standard Order System" from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, telephone (301) 322-4479 or FAX (301) 386-5394. More copies are available from the FAA Internet website at www.faa.gov/certification/aircraft/TSOA.htm.

/s/ Stephen P. Van Trees

Stephen P. Van Trees
Acting Manager, Aircraft Engineering Division
Aircraft Certification Service